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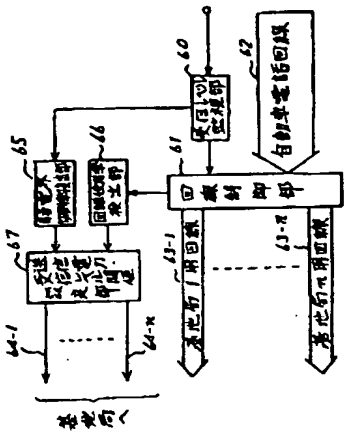
(54) MOBILE RADIO COMMUNICATION SYSTEM

(57) Abstract:

PURPOSE: To improve the quantity of call service by measuring the use rate of respective base station and a disconnect rate in a weak electric field, and changing a sending power and a reception electric field level threshold for speaking channel switching.

CONSTITUTION: In a control station, a speaking channel is switched by a reception level monitoring part 60 and a circuit control part 61 through a car telephone circuit 62 and circuits 63-1@63-n for base stations 1@n. Further, the reception level during speaking is monitored by the reception level monitoring part 60, and a circuit use rate is detected by a circuit use rate detecting part 66, as receiving the disconnect rate due to the weak electric field from a weak electric field disconnect rate detecting part 65, and also necessary data from the circuit control part 61. By adjusting the sending power and the reception level threshold by a sending power.reception level threshold setting part 67 by using the outputs of these weak electric field disconnect rate detecting part 65 and the circuit use rate detecting part 66, a speaking service rate is made maximum. Then, the result is informed to the respective base stations by using signal lines 64-1@64-n.



JP-A 64-29030

[Name of Document] SPECIFICATION

[Title of the Invention]

WIRELESS MOBILE COMMUNICATION SYSTEM

[Scope of Claim for a Patent]

In a communication system comprising a plurality of ground stations for individually taking charge of a plurality of service areas divided on the basis of a specified criteria and adjacent to each other and a control station that controls these ground stations characterized in that a mobile station communicates to the ground station whose transmission waves that reach the mobile station satisfy a specified judgment criteria, a wireless mobile communication system comprising a means for detecting the activity ratio and the disconnection ratio of each ground station at the control station and sending out a control signal for setting the transmission power and the receiving electric field level threshold value of the related ground station to the varied value when the activity ratio and connection ratio of one certain ground station exceed the setting or when there is any vacancy in the circuit of a ground station adjacent to the one certain ground station, and a means for changing the transmission power and receiving electric field level threshold value of its own station when the control signal is received at each ground station, thereby varying the range of service area of the ground station whose transmission

power and receiving electric field level threshold value were varied.

[Detailed Description of the Invention]

[Technical Field Pertinent to the Invention]

The present invention relates to a wireless mobile communication system, and more specifically a wireless mobile communication system applied for public wireless automobile system comprising zone configurations.

[Prior Art]

Conventionally, in Japanese Patent Application No. 56-95196, there is disclosed a patent "wireless mobile communication system" for improving the connection ratio as a whole system that utilizes the wireless mobile communication system by equipping a means for detecting the activity ratio of each ground station at the control station and sending out the transmission electric power control signal for setting the transmission electric power of the relevant one ground station to the varied value when the activity ratio of one certain ground station exceeds the design value and there is a vacancy in the circuit of the ground station adjacent to the one ground station, as well as a means for changing the transmission electric power of its own station when the control signal of the transmission power is received in each ground station and varying the range of the service area of the ground station with the transmission electric power changed in a communication system comprising a plurality of service areas divided by a specified criteria and adjacent to each other, a plurality of ground stations for

individually taking care of these service areas, and a control station for controlling these ground stations, characterized in that the mobile station carries out communication with a ground station whose transmission electric wave reaches the mobile station satisfy the specified judgment criteria.

[Problems that this invention is to solve]

The conventional wireless mobile communication system as described above distributes the traffic loads by measuring the activity ratio at each ground station, increases and decreases the transmission electric power of the ground station between adjacent grounding stations, and varies the service area which the ground station takes care of, but has the following defects with respect to the weak electric field. That is, because the telephone traffic and automobile traffic have a positive strong co-relation and the increase and the decrease correspond to each other, the automobile traffic increases as the telephone traffic increases, and the time required for passing the place between two points also increases, and thereby the communication channel disconnection probability in the weak electric field region increases. In addition, decreasing the transmission electric power of the ground station with increased traffic expands the weak electric field region, and there is a defect that the communication channel disconnection probability further increases.

Accordingly, it is an object of the present invention to provide a wireless mobile communication system that can remove the defects described above and can improve the communication

service ratio (connection ratio, 1/disconnection ratio) by equipping a means for measuring the activity ratio of each ground station and the communication channel disconnection ratio in the weak electric field and varying the transmission power and the receiving electric field level threshold value for switching the communication channel.

[Means for Solving the Problems]

The system according of the present invention is configured by equipping a means for detecting the activity ratio and the disconnection ratio of each ground station at the control station and sending out a control signal for setting the transmission power and the receiving electric field level threshold value of the related ground station to the varied value when the activity ratio and connection ratio of one certain ground station exceed the setting or when there is any vacancy in the circuit of a ground station adjacent to the certain one ground station, and a means for changing the transmission power and receiving electric field level threshold value of its own station when the control signal is received at each ground station, thereby varying the range of service area of the ground station whose transmission power and receiving electric field level threshold value were varied in a communication system comprising a plurality of ground stations for individually taking charge of a plurality of service areas divided on the basis of a specified criteria and adjacent to each other and a control station that controls these ground stations characterized in that a mobile station

communicates to the ground station whose transmission waves that reach the mobile station satisfy a specified judgment criteria.

[Operation]

The wireless mobile communication system according to the present invention comprises a plurality of ground stations for individually taking charge of a plurality of service areas divided on the basis of a specified criteria and adjacent to each other and a control station that controls these ground stations. The principle of the wireless mobile communication system according to the present invention will be described referring to FIG. 5 and FIG. 6.

FIG. 5 is an explanatory drawing showing changes of the service area with respect to the changes of transmission power and receiving electric field level threshold value in the present invention.

In the following description, in order to simplify the description, the transmission power comprises two levels (P large, P small) and receiving electric field level threshold value comprises three levels (TH large>TH ϕ >TH small). In FIG. 5, reference numerals 1 through 7 are seven service areas shown as an example. When the transmission power corresponding to each of the service areas 1 through 7 is same value P small and the receiving electric field level threshold value is same value HT small, each of the service range of the service areas 1 through 7 is shown with the solid line of FIG. 5. In such event, keeping the receiving electric field level threshold value of a ground

station of, for example, service area 1 to TH small and increasing the transmission power increases the service area 1 as shown in broken line. Now, increasing the receiving electric field service threshold value to TH ϕ (>TH small) can return the service area 1 to the solid line, and further increasing the receiving electric field service threshold value to TH large (> TH ϕ) can reduce the region of the service area 1 in an alternate dot and short dash line.

By the foregoing, when the communication traffic, that is, the circuit activity ratio does not exceed the design value and the disconnection ratio by the weak electric field exceeds the setting, increasing the transmission power of the relevant ground station and changing the receiving electric field level threshold value from TH small to THϕ can improve the disconnection ratio due to weak electric field without changing the service area.

FIG. 6 is an explanatory drawing showing a method for improving the communication service ratio of the service area in which both disconnection ratio by weak electric field and circuit activity ratio exceed the design values.

In FIG. 6, reference numerals 10 through 19 indicate service areas. In FIG. 6, assume that the disconnection ratio and circuit activity ratio of the service area 10 are higher than the design values, and of the service areas adjacent to the service area 10, that is, service areas 11, 12, 13, 14,15, 16, that with margin in the circuit is service area 11 only. In such event, the transmission power of the ground station

corresponding to service areas 10, 11 only is increased from small to large, that is, from P small to P large, and the transmission power of other ground stations shall be kept P small. In addition, the receiving electric field level threshold value only of the ground station 10 is increased and the receiving electric field level threshold value of other ground stations was kept to TH small.

By the following processing, the region of the service area 10 is reduced and the calling amount from the service area is reduced, and the circuit connection ratio improves. In addition, increasing the transmission power of the ground station 10 reduces the weak electric field region, and can reduce the disconnection ratio due to weak electric field.

Making the best of the above principle, the present invention provides a wireless mobile communication system that enables a remarkable improvement in the communication service ratio.

[Mode for carrying out the Invention]

Referring now to drawings, the present invention will be described more in detail. FIG. 1 is a configuration drawing showing one embodiment of a control station in the wireless mobile communication system according to the present invention. Based on FIG. 1, discussion will be made on communication channel switching by the receiving level monitoring section 60 and the circuit control section 61.

FIG. 2 is a flow chart showing processing of the ground station while the mobile unit is in communication.

The ground station incorporates a mobile unit timeout monitoring section, receiving level monitoring section, receiving level judging section, and notifying section, and they carry out processing that corresponds to Steps 201 through 04 of FIG. 2.

Step 101 of FIG. 2 shows the operation of mobile unit timer/timeout monitoring section, Step 202 the receiving level monitoring section, Step 203 the receiving level judging section, and Step 204 the operation of the control section to the notifying section, and reference numerals 1 and 2 in FIG. 2 show the relationship with the flow chart of FIG. 3 later discussed.

In each ground station, after Step 201, operation moves to Step 202, and using the receiving level monitoring section, the receiving level during communication is monitored for each communication channel. Further, Step 203 is executed, but this judges whether the receiving electric field level is THi (the ith ground station receiving electric field level threshold value) or lower, which is instructed by the control station, and if the receiving level is greater than the threshold value, the mobile unit is regarded to exist in the same service area. On the other hand, if the receiving level is lower than the threshold value, the mobile unit is regarded to come closer to the boundary of the service area and the operation moves to Step 204. In Step 204, the degradation of the receiving level is notified to the control station. The mobile unit timer/timeout monitoring section that processes Step 201 is to alleviate

processing when a service area has a plurality of receiving electric field level threshold values such as TH ϕ and TH large as is the case of the service area 10 of FIG. 6. The flow of Step 204 links to FIG. 3.

FIG. 2 shows a flow chart of the processing contents of the control station. In FIG. 3, Step 301 corresponds to the processing by the monitoring instruction section, 302 the receiving level measurement result collection section, 303 the receiving level upper 2 ground station detection section, 304 the top receiving level ground station judging section, 305 the transmission power judging section, 306 the receiving level judging section, 307 the vacancy head end section of the ground station of the top receiving level, 308 the vacancy channel selecting section of the ground station whose receiving level is the second high, and 309 the mobile unit timer value notification section, respectively, and the control station incorporates each of these sections and executes the following processing.

The control station possesses the information on the magnitude of transmission power of each ground station and the receiving electric field level threshold information. In Step 301, monitoring of the receiving electric field level is instructed to the ground station that has notified the degradation of the receiving level and to adjacent ground stations by the receiving level monitoring instruction section, then, using the receiving level measurement results collecting section, Step 302 for collecting measurement results of the

receiving electric field level of the notifying ground station and adjacent ground station is executed. Then, by the receiving level top 2 ground station detection section, Step 303 is executed, and at Step 303, the top 2 ground stations in the measurement results are selected. In Step 304, if the top receiving level ground station is not the notifying ground station, Step 307, selection of the vacant channel of the ground station whose receiving level is the top, is executed, and then, Step 308 for notifying the vacant channel number to the destined ground station is executed. It is the case in which the weak electric field portion in the service area is moving to the outside of the system service area when the top receiving level ground station is the notifying ground station and the transmission power of the notifying ground station is small by Step 305. On the other hand, when the top receiving level ground station is the notifying ground station and the transmission power of the notifying ground station is large, the receiving level can be classified into two by Step 306 on the basis of the receiving level of the ground station whose receiving level is second high. When the receiving level is greater than TH small, it is regarded that the mobile unit has already moved to the adjacent ground station, and by Step 308, the vacant channel is selected and then, the operation is advanced to Step 309 where the vacant channel number is notified to the destined ground station. On the other hand, if the receiving level is smaller than TH small, the mobile unit is regarded to still exist in the service area of the notifying ground station, and the

mobile unit timer value is notified to the notifying station and Step 310 is executed. The operation flow of Step 309 links to FIG. 5 and the operation flow of Step 310 links to FIG. 2, respectively.

FIG. 4 is a flow chart showing the processing contents of the destined ground station. Step 401 shows processing by the vacant channel number notifying section.

Reference numeral 3 links to the processing flow of Step 309 of FIG. 3, and in the destined ground station, channel switching is carried out on the basis of the vacant channel number notified by the control station.

Again, returning to FIG. 1 to continue description on the control station. The control station comprises a receiving level monitoring section 60, circuit control section 61, weak electric field disconnection ratio detecting section 65, circuit activity ratio detecting section 6, and transmission power and receiving level threshold value setting section 37, and carries out communication channel switching shown in the processing flow chart of the control station of FIG. 3 via the receiving level monitoring section 60, automobile telephone circuit 62 in the circuit control section 61, and circuit for ground station 1 through circuits for n, 63-1 through 63-n, while the control station monitors the receiving level during communication by the receiving level monitoring section 60, detects the disconnection ratio due to the weak electric field by the weak electric field disconnection ratio detecting section 65 and the circuit activity ratio by the circuit

activity ratio detecting section 66 while receiving necessary data from the circuit control section 61, and adjusts the transmission power and the receiving level threshold value at the transmission power and receiving level threshold value setting section 67 making the best of the outputs of the weak electric field disconnection ratio detecting section 65 and the circuit activity ratio detecting section 66, and thereby achieves the maximum communication service ratio. The results are notified to each ground station using the signal lines 64-1 through 64-n.

[Effect of the Invention]

As described above, the present invention has effects of remarkably improving the communication service ratio by measuring the activity ratio and disconnection ratio at the weak electric field at each ground station, and varying the transmission power and the receiving electric field level threshold values for switching communication channels.

[Brief Description of the Drawings]

[Fig. 1]

FIG. 1 is a block diagram showing the configuration of one embodiment of the control station in the wireless mobile communication system according to the present invention;

[Fig. 2]

FIG. 2 is a flow chart showing processing of ground station while the mobile unit is in communication;

[Fig. 3]

FIG. 3 is a flow chart showing the contents of processing

of the control station;

[Fig. 4]

FIG. 4 is a flow chart showing the processing contents of the destined ground station;

[Fig. 5]

FIG. 5 is an illustration showing changes of the service area with respect to the changes of the transmission power and receiving electric field level threshold value in the present invention; and

[Fig. 6]

FIG. 6 is an illustration showing a method for improving the communication service ratio of the service area where both disconnection ratio due to weak electric field and circuit activity ratio exceed the design values.

[Description of reference numerals]

1-7, 10-18 Service areas

60 Receiving level monitoring section

61 Circuit control section

62 Automobile telephone circuit

63-1 to 63-2 Circuit for ground station 1 to circuit for ground station n

64-1 to 64-n Signal lines

65 Weak electric field disconnection ratio detecting section

66 Circuit activity ratio detecting section

67 Transmission electric power and receiving level threshold value setting section

FIG. 1

TO GROUND STATION

67 TRANSMISSION ELECTRIC POWER AND RECEIVING LEVEL THRESHOLD VALUE SETTING SECTION

65 WEAK ELECTRIC FIELD DISCONNECTION RATIO DETECTING SECTION

66 CIRCUIT ACTIVITY RATIO DETECTING SECTION

63-1 CIRCUIT FOR GROUND STATION 1

61 CIRCUIT CONTROL SECTION

60 RECEIVING LEVEL MONITORING SECTION

63-N CIRCUIT FOR GROUND STATION N

62 AUTOMOBILE TELEPHONE CIRCUIT

64-1 TO 64-N SIGNAL LINES

FIG. 2

GROUND STATION WHILE THE MOBILE UNIT IS IN COMMUNICATION

201 MOBILE UNIT TIMER TIME-OUT?

202 RECEIVING LEVEL MONITORED

203 THI OR LOWER?

204 LEVEL DEGRADATION NOTIFIED TO CONTROL STATION

FIG. 3

CONTROL STATION

RECEIVING LEVEL MONITORING SECTION 60

CIRCUIT CONTROL SECTION 61

301 MONITORING OF RECEIVING LEVEL INSTRUCTED TO NOTIFYING GROUND STATION AND ADJACENT GROUND STATION.

302 RECEIVING LEVEL MEASUREMENT RESULTS COLLECTED.

303 RECEIVING LEVEL TOP 2 GROUND STATIONS DETECTED.

304 IS GROUND STATION WITH THE HIGHEST RECEIVING LEVEL THE NOTIFYING GROUND STATION?

305 IS TRANSMISSION POWER OF NOTIFYING GROUND STATION SMALL?

306 RECEIVING LEVEL>THM IN GROUND STATION WITH SECOND HIGH RECEIVING LEVEL?

307 VACANT CHANNEL OF HIGHEST RECEIVING LEVEL GROUND STATION SELECTED.

308 VACANT CHANNEL OF SECOND HIGHEST RECEIVING LEVEL GROUND STATION SELECTED.

309 VACANT CHANNEL NUMBER NOTIFIED TO DESTINED GROUND STATION.

310 TIMER VALUE FOR MOBILE UNIT NOTIFIED TO NOTIFYING STATION.

FIG. 4

DESTINED GROUND STATION

401 VACANT CHANNEL NUMBER NOTIFIED TO MOBILE UNIT.

FIG. 5

1-7 SERVICE AREA

P SMALL, P LARGE TRANSMISSION POWER (SMALL, LARGE)

TH LARGE, TH ϕ, TH SMALL RECEIVING ELECTRIC FIELD LEVEL THRESHOLD VALUE

(TH LARGE>TH ϕ>TH SMALL)

FIG. 6

10-18 SERVICE AREA

P SMALL, P LARGE TRANSMISSION POWER (SMALL, LARGE)

TH LARGE, TH ϕ, TH SMALL RECEIVING ELECTRIC FIELD LEVEL THRESHOLD VALUE

(TH LARGE>TH ϕ>TH SMALL)